Bone and Joint Diseases

Management of broken legs

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The treatment of fractures of the tibia and fibula has been a subject of recurring controversy for at least half a century. The main point in dispute has been whether or not these fractures should be internally fixed as a primary method of treatment. The controversy relates, of course, to fractures in adult bones, for almost all surgeons are agreed that internal fixation has little or no part to play in the ordinary fractures of children. Recently new and better methods of internal fixation have been introduced and consequently the controversy has been revived.

The Swiss group of surgeons, who call themselves Arbeitsgemeinschaft für Osteosynthesefragen—commonly referred to as the AO group—have designed and so improved their system of internal fixation and their instruments that they have caused an upheaval in fracture treatment in many countries. Consequently many surgeons have been stimulated to re-examine long-cherished beliefs and to reappraise time-honoured methods of treatment. I propose to survey the current treatment of fractures of the shafts of the tibia and fibula. I will not consider injuries of the knee and ankle, since each is a separate subject in its own right. Details of operative technique will not be discussed.

Diagnosis

Diagnosis seldom presents problems except in young children who fall unobserved and subsequently cannot stand, locate their pain, or describe their symptoms; the injury is not uncommonly a spiral fracture of the tibia that may not be obvious clinically or even in the radiograph. Stress fractures may also be difficult to detect unless the possibility is remembered. An incomplete diagnosis in a patient with serious multiple injuries may have grave consequences; such a patient may be taken to the operating theatre to have his tibia plated at a time when he has a leaking rupture of the aorta or an undetected fracture-dislocation of the cervical spine.

When appropriate the radiographic examination should include films of the knee, ankle, and foot; in a limb with generalised swelling associated fractures are often undetected.

The causal violence is of first importance in both prognosis and treatment. Injuries from sports and games often heal quickly, though there are a few notable exceptions. Skiing injuries generally have a good prognosis, and statistics compiled from centres where many such injuries are treated should be interpreted with caution when different methods of treatment are compared. Fractures caused by great violence such as high-speed road accidents have a much worse prognosis as regards both duration of disability and final function.

The presence of a compound wound is not of itself of great importance. The tibia is a subcutaneous bone, and the fracture may be

compound only in a technical sense. The claim that compound tibial fractures can be treated by immediate internal fixation is therefore unimportant: in most centres where such operations are done the patients are carefully selected. It is much more important to recognise that, although the fracture is closed, the skin may have been severely contused. This may not be obvious soon after injury and if the tibia is plated immediately the skin may slough, with disastrous consequences.

CLASSIFICATION

To classify these fractures accurately is difficult. Among the possible adverse factors few can be precisely measured. A widely displaced closed fracture may have a much worse prognosis than a technically compound one. The displacement shown in the initial radiograph after splintage may bear no relation to that which occurred at the time of injury. The force that produced the fracture, which is of great importance, cannot be measured except in animals (and these studies have their own limitations as the results are not always comparable with those in human fractures). The shape of the fracture is of some value in prognosis and treatment: the spiral fracture is usually quick to heal while the transverse and oblique fractures usually unite more slowly. Comminution is usually unfavourable. An intact fibula sometimes delays the healing of a severely broken tibia but it often helps to prevent serious deformity and makes secondary operations easier.

Wide displacement of the main fragments when shown in the initial radiograph is always unfavourable. It indicates that the adjacent soft tissues have been severely damaged. The converse is not true, because severe displacement may have been corrected before the initial radiographs were obtained. For these reasons a controlled clinical trial in man would present almost insuperable difficulties.

Preliminary investigations

First aid—A compound wound must be covered with a clean dressing as soon as possible and a splint applied. Many ambulance crews now carry inflatable air splints or strips of semi-resilient sorbo material that may be bandaged to the limb. Both are satisfactory for first-aid use.

Physical examination—Though the diagnosis is usually obvious a careful examination of the leg is important. The pedal pulses should be sought (they are often difficult to feel soon after injury) and sensation and movement in the toes tested if possible. In road accident patients and other victims of severe trauma serious injuries to other parts of the body must be excluded.

Investigations—Good radiographs are of great importance, although the standard views cannot always be obtained. The importance of excluding injuries to the knee, ankle, and foot in appropriate cases has been mentioned. In those with severe multiple injuries blood must be sent for grouping and matching.

Treatment

Treatment is currently controversial. There are those who hold that nearly all adult tibial fractures should be internally fixed as a primary procedure; at the opposite extreme are those who are almost

wholly conservative. In the middle ground is a small group who reserve open reduction and internal fixation for selected fractures. The merits and hazards of these approaches will now be considered.

PRIMARY INTERNAL FIXATION

Those dedicated to primary internal fixation hold that the results of closed treatment are unsatisfactory; they maintain that treatment in plaster causes serious and permanent joint stiffness that can be prevented by early rigid fixation. They also maintain that the improved results justify the hazards and complications of internal fixation. In support of this method it may be said that early operation is often easy to perform, particularly if there is no comminution. If there are no complications and healing proceeds uneventfully all agree that the anatomical and functional results can be very satisfactory. Unfortunately these apparent advantages cannot be accepted at their face value. The patients treated by internal fixation are often a selected group in whom a good result may be expected either from internal fixation or from closed treatment in plaster.

The true results of the two methods cannot be compared. As Nicoll¹ has said, even the most venturesome surgeon would not attempt primary internal fixation in a leg in which the skin and soft parts have been severely mangled. These have to be treated without internal fixation and for this reason alone it is impossible to make a fair comparison between the results of internal fixation and closed treatment.

Methods of internal fixation

The AO method—While there seems general agreement that the most advanced techniques are those designed by Müller² and his colleagues in Switzerland (the AO method), rigid fixation may be achieved with some of the older designs of plates and screws. Very rigid fixation may be achieved by the use of two Sherman plates³ applied at a right angle to one another but this method should not be used for fresh fractures; swelling from a recent injury may make closure of the skin difficult or impossible. Relieving incisions will not always solve this problem.

Intramedullary nails, which are so suitable for certain femoral fractures, are less often used in the tibia. They are more difficult to insert and the rigidity of fixation is usually inferior to that from a well-applied plate. Despite previous teaching, this method should not be used in patients with damaged skin.³

Hicks plate—This was produced by J H Hicks in 1957 having been designed especially for the internal fixation of tibial shaft fractures. The plate is large and strong. Though it affords rigid fixation, it is associated with many complications⁴—notably skin necrosis, exposure of the fracture, and secondary infection. The Hicks plate is available in vitallium; corrosion is uncommon, and the implant can often be left in place after the fracture has healed.

Conventional plates of the Venable and Sherman type (there are many other good patterns also available) have been used by the older generation of fracture surgeons, not all of whom believe that compression fixation is necessary for the successful treatment of these fractures. I find that the use of two large Sherman plates affords excellent fixation; it must be repeated that two-plate fixation must not be used for fresh fractures.

First-intention bone healing

First-intention bone healing is a strange term that is currently used by surgeons who practise early rigid fixation as the treatment of choice for fractures of the shaft of the tibia. If the fracture thus treated heals without the formation of any external callus the internal fixation is judged to be a complete success. If external callus is visible it is held that first-intention fracture healing has not been achieved.

A child's tibia when fractured often heals quickly and well with a well-defined sheath of external callus. To suggest that such a natural and desirable outcome is not first intention bone healing is undesirable. I think that the term first-intention bone healing need not and should not be used. The appearance of callus does not mean that rigid fixation was not achieved. If for example internal fixation is done 7-21 days after injury, external callus will often form whether the fixation is rigid or not.³ Periosteal callus in a shaft fracture of the tibia is not detrimental to good joint function and is often rewarded by rapid healing of the fracture.³

Results of early internal fixation

I reported a series of early internal fixations³ the results of which were unsatisfactory. There was a high incidence of both infection and delayed union. Olerud and Karlström⁵ would appear to have had a lower incidence of infection but they too emphasise the frequency of healing disturbances and prolonged incapacity. In the latter series the AO method was used and most fractures were treated by early operation. Hicks⁴ has warned of the high incidence of complications after rigid internal fixation.

All protagonists of early rigid fixation seem pleased with the good joint function that their patients have achieved. However this may be, I have found the incidence and the severity of complications to be so high as to be unacceptable. Far fewer complications resulted when operation was done as an elective procedure after the initial swelling had subsided. The functional results from delayed primary internal fixation were excellent.³

Immediate rigid fixation without primary skin closure

To repair a serious wound in a limb by delayed primary closure is often a sound surgical procedure; its safety has been established beyond all reasonable doubt. Nevertheless, to plate a fresh fracture of the tibia and leave the wound open with a view to secondary suture presents at least two serious hazards. Firstly, the skin may slough from the causal violence making delayed primary closure with normal skin impossible. Secondly, and this is not yet widely recognised, the immediate internal fixation of a severe shaft fracture always delays healing of the fracture. It is better therefore to obtain sound healing of the skin and if internal fixation of the fracture is indicated to do this as a delayed primary procedure.

Closed treatment by manipulation and applying a plaster cast

Closed treatment by manipulating and applying a plaster cast has been tried and tested over many years, and most surgeons who have learned the details of closed treatment are well satisfied with the results. These views are amply confirmed by Nicoll¹ in a large series of conservatively treated fractures. The techniques of conservative treatment are well known and do not require detailed description. Skeletal traction is useful in certain fractures and does not delay healing.¹

The essentials of closed treatment are: (1) the prompt and efficient treatment of a compound wound if the fracture is open; (2) the restoration of adequate length and correct alignment and the avoidance of rotational deformity using skeletal traction when indicated; and (3) proper after-care to ensure that deformities do not occur, that plasters are changed and wedged when necessary, and that physiotherapy is given from the outset and not only after the limb comes out of plaster. Early weight bearing is beneficial, and there is good reason to believe that this reduces muscle wasting and joint stiffness, and accelerates healing. (It is seldom wise to allow early weight bearing in patients treated by immediate rigid internal fixation as this may cause the plate to work loose.)

All the essentials of good reduction can usually be attained without recourse to internal fixation, and satisfactory healing may be expected in 95% of cases.¹ No case can therefore be made for a wholesale resort to internal fixation. I know of no large series of patients who have been treated by early internal fixation without a high incidence of serious complications.

Function and joint range

On the balance of available evidence patients successfully treated by internal fixation probably obtain a slightly better range of ankle and tarsal movement than those treated in plaster. On the debit side patients treated by internal fixation suffer severe and frequent complications: delayed union, deep wound infection, refractures, and new fractures—also corrosion in some cases if the metal is not removed. Infection or corrosion may necessitate removal of the metal before the fracture has healed.

One consequence of injury that Nicoll¹ made clear and which is of great practical importance is that a loss of ankle range of 25% or less is usually not detectable by the patient and does not therefore amount to a disability. It needs an expert to detect 12½% loss of dorsiflexion and a similar loss of plantar flexion. A 75% range of ankle movement,

or more, is often achieved by good conservative treatment and practically this amounts to a full functional recovery. The morale and motivation of the patient are more important than the measurement shown by the goniometer. I know young men who recovered a 70% ankle range who subsequently played football, and others with better ranges than this who considered themselves disabled.

The closed method of treatment demands as much skill, care, and attention to detail as the operative method. Early weight bearing and, in the later stages of treatment, the use of short plasters and below-knee calipers contribute to rapid rehabilitation.

Delayed union is common in the more severe fractures with serious soft tissue damage. In these, long periods in plaster are increasingly detrimental to joint function. If a fracture is still clinically movable after 12 weeks in plaster, rigid internal fixation is often indicated. If the fracture is clinically firm though not fully healed the plaster can occasionally be removed and active exercises started without weight bearing. When dealing with alcohol addicts and uncooperative patients special precautions are needed and the plaster must not be removed until the fracture is completely healed. I prefer to use two-plate fixation for delayed union; rigid fixation results, no plaster is needed, and weight bearing may often be started six weeks after operation.

RIGID EXTERNAL FIXATION

With comminuted bones and badly crushed muscles even the most enthusiastic exponent of internal fixation hesitates to nail or plate the fracture. For such injuries rigid external fixation using multiple transfixion pins incorporated in plaster is again becoming fashionable. The method was tried and discarded some years ago but has been revived with modifications; the benefits claimed are not very convincing and history may repeat itself. To transfix bones, muscles, and other soft tissues at multiple levels and then encase the limb in plaster does not seem likely to improve joint function. A better plan is to secure healing of the skin and soft parts as soon as possible and, in suitable cases, to resort without undue delay to rigid internal fixation with bone grafting if necessary.

If scars make the use of conventional exposures inadvisable a posteromedial or posterolateral approach may be used. The experienced surgeon can usually obtain and preserve good alignment of the bones, and this facilitates internal fixation in the later stages of treatment.

BONE GRAFTS

Bone grafts are used much less often than formerly—rigid internal fixation has largely made bone grafting unnecessary and is the treatment of choice for delayed union. Little or no splintage is needed after operation, and the joints may be actively exercised after the wound has healed.

When a segment of bone has been lost (often due to ill-advised primary surgery) a bone graft is needed to restore the defect. Ideally this bone graft should be combined with rigid internal fixation. It is often wise to stage these procedures to lessen the risk of infection and loss of the graft.

BONE SEPSIS

Bone sepsis after internal fixation may be very serious needing months or years of treatment to eradicate it. The patient will occasionally demand amputation. These tragedies are more common than reports would suggest. In almost every large series there are one or two amputations owing to incurable sepsis. The suggestion that bone sepsis is unimportant and can be cured by the expert should be disregarded. The bone sepsis that results from primary internal fixation may be exceedingly serious, much more so than the sepsis that follows treatment without internal fixation. In fractures treated conservatively secondary amputation is seldom needed. In Nicoll's large series¹ it was less than 0.5%. The suggestion that to treat severe tibial fractures by immediate rigid internal fixation actually lessens the risk of serious infection does not merit serious consideration.

When infection does occur after internal fixation it is, of course, unwise to remove the plate or nail so long as the implant contributes to stability. More often than not absorption of bone occurs next to the

infected area and plates and screws work loose. At this stage the metal must be removed. There is no satisfactory alternative.

INDICATIONS FOR OPEN REDUCTION AND INTERNAL FIXATION

Potentially stable compound fracture—Open reduction by itself without immediate internal fixation may be of value in certain compound fractures in which a stable reduction can be obtained. This may usually be done through the original wound or by extending it to a small extent. To hold the reduction while the plaster is being applied calls for some care and gentle handling of the leg but if this can be done the after-treatment is easier, particularly if internal fixation is indicated at a later stage. Generally, when using closed treatment, high standards of reduction are desirable and may often be obtained by those trained in closed treatment. In the later stages of treatment it is easy, reliable, and safe to fix internally a fracture that is in good alignment.

Comminuted fracture with an irreducible middle segment may indicate early surgical intervention. If a stable position can be obtained by open reduction alone immediate internal fixation should be avoided. If the reduction is unstable internal fixation is justifiable. If the limb is swollen and the skin bruised the use of a small non-rigid implant may be wise pending a rigid fixation at a later date, after the initial swelling has subsided and the skin is soundly healed.

Delayed union—While short periods of plaster treatment for 10 to 12 weeks do little or no permanent harm to the joints of the affected limb, immobilising damaged tissues for longer periods is often undesirable. A fracture that shows obvious mobility after 12 weeks in a plaster cast should usually be treated by rigid internal fixation. It is best not to disturb the existing fibrous union, if the bones are in acceptable alignment, when internally fixing the fracture.

Multiple fractures in the same limb—It is relatively common, particularly after traffic accidents, for the femur and the tibia to be broken in the same limb. Such injuries can be treated by closed methods but to fix one or both fractures internally sometimes gives a better functional result. The operations are best done as delayed primary procedures. As the skin of the thigh is usually less severely damaged than that of the leg, the femur is internally fixed first and the tibia a few days later.

Fractures of the knee and ankle joints—Immediate operation is the treatment of choice in those patient in whom internal fixation is indicated. The treatment of these fractures is outside the scope of this paper.

FRACTURES WITH MAJOR VASCULAR INJURIES WHEN A MAIN ARTERY HAS TO BE REPAIRED

Contrary to widely held belief, primary internal fixation of a fracture with major vascular injuries is not indicated. It is much easier to repair the artery by letting the bone fragments overlap during operation and the ends of the torn vessel may be adequately trimmed if necessary.

If the resulting defect is too large for direct suture a reversed saphenous vein graft is used. Soft tissue should be interposed between the vascular anastomosis and the fractured bone ends. Heavy traction must be avoided but external splintage is adequate, and the fracture heals more quickly with slight overlap of the fragments.

Conclusion

Where properly indicated and expertly used, modern methods of internal fixation with implants of high quality have improved the results of treatment in difficult fractures. It needs to be emphasised, however, that in treating the fractured tibia internal fixation is seldom necessary. The results of closed treatment are satisfactory in most patients and immediate internal fixation is associated with many complications, irrespective of the quality or method of internal fixation.

Internal fixation should therefore be reserved for problem fractures and for treating certain cases of delayed union. "The routine use of compression plates on fractures of the tibia is indefensible."⁶ Internal fixation is a valuable complement to

closed treatment and not a justifiable substitute for the latter method. Rigid internal fixation of the tibia should be regarded as an elective operation—to be done by the experienced fracture surgeon using an atraumatic technique. The immediate internal fixation of a fresh tibial shaft fracture should not be routine; early internal fixation delays healing and is surgically unsafe. The risk of serious infection is unacceptably high. Closed treatment is therefore the method of choice for most of these injuries.

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Clinics in General Practice

A case of haematuria

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The trainee's problem

It took her several days to summon up courage to consult me about the blood she had passed in her urine. In fact, it perhaps took two years, as this was the second time it had happened, on both occasions with symptoms suggesting concurrent infection. This more recent episode occurred after having intercourse with her husband for the first time for over six months. When I saw her a week afterwards she was symptom-free, and it was difficult to ascertain whether the blood had been from the bladder or from elsewhere in the urinary tract. The urine culture was sterile and blood was absent from the urine.

The patient is 53 and seems basically happy but anxious. Her mother died recently after needing home nursing because of a hemiplegia and she had coped much better than anyone thought she could. She has two outstanding fears—one of hospital and investigation and the other of malignant disease. Unfortunately the latter has been heightened by her sister dying of cancer (she doesn't know of what) two years ago. The patient had a hysterectomy for fibroids 12 years ago; at least in part I think this operation was eventually precipitated by her fear of malignancy and it aggravated her other fear—that of again needing investigation or surgery.

I realise that she has probably nothing seriously wrong but find she is putting too much pressure on me to guarantee she has "nothing to worry about." Should I protect myself by referring her to hospital or should I be referring all patients with haematuria in any case? And can I reasonably ask the consultant to restrict what investigations he does in order not to upset the patient?

General practitioner's comments

The problem here, to some extent, is that the doctor's faith in his clinical judgment is disturbed by the patient's fears of more

serious underlying diseases and her anxiety about possible hospital investigation. He admits to too much pressure being put upon him to guarantee her safety and that his principal reason for referring her might be merely to protect himself.

Close examination of the history shows that this is the second episode and that the initial episode of haematuria was about two years ago. Another aspect suggestive of a benign underlying cause is the association with symptoms suggesting concurrent urinary infections. The patient herself, however, may not have properly identified the source of the bleeding. She came to the doctor a week later, when there were no symptoms and when her urine was found to be sterile and free of blood. There is no way of being certain, for example, that the blood was not primarily vaginal in origin. There is a little evidence to support this possibility in the relationship of the haematuria with intercourse. This latter aspect introduces the additional possibility that this was urethritis. If a differential diagnosis were constructed here urinary tract infection should be considered first, then urethritis and menopausal vaginitis.

Some preliminary investigations could be carried out by the doctor himself to eliminate these possibilities. He has already examined the urine, and this should be repeated on several occasions and a bacterial count requested. Careful vaginal examination and assessment of the vaginal mucosa are indicated. Further investigation of the urinary tract by intravenous pyelography could be carried out if open access facilities are available. When he has completed these investigations he will not have confirmed his patient's fear that to consult her doctor about such a symptom is to invite an immediate referral to hospital and to specialist investigation. Instead he will have, perhaps, built up her confidence in him as a primary care physician, and this can only benefit her relation with the practice in future.

CLINICAL APPROACH

Probably the patient is somewhat depressed after the recent death of her mother from a lengthy illness. We know of her fear of cancer, now heightened by the death of her sister only two years ago. A firm but sympathetic approach will be necessary to deal with her present problem within the practice. At the same time an opportunity to ventilate her depressive symptoms and anxieties may be therapeutic. A much more serious symptom could be suppressed in the future, if she were to assume that consultation with her doctor resulted in immediate referral to

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